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V. *A Letter from Captain John Waddell to Mr. Naphthali Franks Merchant, concerning the Effects of Lightning in destroying the Polarity of a Mariners Compass; to which are subjoined some Remarks thereon, by Gowin Knight, M. B. F. R. S.*

S I R,

Horshydown, Feb. 22, 1748-9.

*Read April 13.
1749.*

A Greable to my Promise I have here inclos'd you the Heads of our Misfortune, and have also sent you one of the Compasses, and am, with great Esteem,

S I R,

Your most obedient humble Servant,

John Waddell.

ON the 9th of *January* 1748-9. the new Ship *Dover*, bound from *New York* to *London*, being then in Lat. 47° 30' North, and Longitude 22° 15' West, from *London*, met with a very hard Storm of Wind, attended with Thunder and Lightning, as usual, most Part of the Evening, and sundry very large Comazants (as we call them) over-head, some of which settled on the Spintles at the Top-mast Heads, which burnt like very large Torches; and at 9 *p. m.* a single loud Clap of Thunder with Lightning struck the Ship in a violent manner,
which

which disabled myself, and great Part of the Ship's Company, in the Eyes and Limbs; it struck the Mainmast about $\frac{2}{3}$ up almost half-through, and stove the upper Deck one Carling, and Quick-work; Part of which Lightning got in between Decks, started off the Bulk-head, drove down all the Cabbins on one Side of the Steerage, stove the lower Deck, and one of the lower Deck main Lodging-Knees.

Another Part of it went through the Starboard Side, without any Hurt to the Ceiling (or inside Plank); and started off from the Timbers four outside Plank being the Whale upwards; one of which Planks, being the second from the Whale, was broke quite asunder, and let in, in about 10 or 15 Minutes time 9 Feet Water in the Ship.

It also drew the Virtue of the Loadstone from all the Compasses, being four in Number, all in good Order before, one in a brass and three in wooden Boxes. The hanging Compass in the Cabbin was not quite so much disabled as the rest; they were at first very near revers'd, the North to the South; and after a little while rambled about so as to be of no Service. The Storm lasted five Days, we lost our Mainmast and Mizenmast, and almost all our Sails; arriv'd at *Cowes* the 21st of *January* in a very shatter'd Condition.

An Account of the Mariners Compass, that was struck with Lightning, and shewn at the last Meeting of the Royal Society; with some further Particulars relating to that Accident; communicated by Gowin Knight, M. B. F. R. S.

WHEN I came to examine the Compass struck with Lightning, I observed that the outward Case was joined together with Pieces of iron Wire, 16 of which were found in the Sides of the Box, and 10 in the Bottom. I applied a small Needle to each of these Wires, and immediately perceived that the Lightning had made them strongly magnetical; particularly those that joined the Sides. All the Heads of the Wires on one Side of the Box attracted the North Point of the Needle, and repelled the South; whilst all the Heads on the other Side attracted the South and repell'd the North. The Wires at the Bottom attracted the South and repelled the North; but it is not certain, whether this Polarity was any-ways owing to the Lightning; since it might be acquired by their continuing long in an erect Posture.

In examining the Card, I found the Needle was vigorous enough in performing its Vibrations, but that its Polarity was inverted; the North Point turning constantly to the South. I then tried to take out the Card, to examine the State and Structure of the Needle: But the Junctures were every-where well-secured with Putty, and that grown so hard, that I was obliged to use some Violence, and at last broke the Glass. The Needle (if I may so call it)

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consisted of two Pieces of Steel Wire, each of which was bent in the middle, so as to make an obtuse Angle; and the Ends of these Wires applied together, forming an acute one, the whole appear'd in the Shape of a Lozenge; in the Centre of which was placed the brass Cap whereon the Card turned. And so far was it from being made with any tolerable Degree of Exactness, that there was not the least Care taken either to bend the Wires in the middle, or to fix the Cap exactly in the Centre of the Lozenge: For, upon trying it with a Pair of Compasses, I found its greatest Eccentricity to be full $\frac{2}{10}$ of an Inch. The Pin, upon which it turned was made of a Slip of Plate-Brass sharpened to a Point.

Besides the Particulars already communicated to the Society, the Captain informed me, that he was obliged to sail above 300 Leagues, after this Accident happen'd, without a Compass, till he arrived at *Cowes* in the *Isle of Wight*; where being provided with one, he placed it in the Binacle, but was much surprized to find that it varied from the Direction it stood at when out of the Binacle nearly 2 Points. He removed the Binacle to different Parts of the Deck, but found that it always made the Needle to vary after the same manner when placed in it. He repeated the same Experiment lately in the River, with the like Success; only that he observed, that the Variation of the Needle, when placed in the Binacle, was rather less than at first. It was natural to inquire if there was any Iron about the Binacle; but I was surprized when the Captain informed me, he had given strict Charge to the Maker not to put so much as a single Nail in it; and that he firmly
believed

believed that there was not the least Bit of Iron about it.

Being willing to be satisfied of the Truth of a Circumstance so very extraordinary, the Captain was desired to send the Binacle to a House in the City ; where, in Company with the Captain, Mr. *Ellicot*, and another Gentleman, I tried it with a large Compass touched by my Bars ; but finding no sensible Variation, we at that time desisted, thinking the Fact quite improbable : But having discovered the Effect which the Lightning had produced upon the Wires which fastened the Sides of the Compass-Box, I was induced to examine the Binacle a second time ; which I did with a small Compass, and with great Care, in every Part ; and at last, about the middle of the Binacle, I found it to vary very sensibly, but could not discover any Nails or Iron any-where thereabouts ; till, turning it up to examine the Bottom, I there found 3 or 4 large Nails, or rather Spikes, driven thro' it to fasten the upright Partitions in the middle of the Binacle.

It would not be difficult to explain why any Needles, under the like Circumstances with those above-related, should be render'd useless by Lightning, tho' the Needles themselves had remained unhurt. So many iron Wires made strongly magnetical would doubtless have effected it ; and 3 or 4 large Nails in the Binacle, if made magnetical, would alone have been sufficient to have done it. But I have already taken notice that the Polarity of the Needle was inverted by this Accident ; and I would further observe, that all Needles constructed after this manner are liable to be render'd useless, not only by the

Lightning's destroying their Virtue, but also by its placing it in a particular Direction; *e. g.* if the Lightning struck the Needle in the Direction of either of the two parallel Sides of the Lozenge, it must strike the other two Sides very obliquely; whereby the first two Sides may have their Polarity destroyed, and a very strong one given them in the contrary Direction; whilst that of the other Sides, if it be inverted, will be very weak; but it is probable that the Virtue would be placed obliquely in the Direction of the Stroke; in either Case, these two Sides can contribute but very little (if any thing) in directing the Card; and if the two first Sides only are capable of acting upon it, it will point in the Direction of those Sides, which will produce a Variation of about 4 Points.

It may further be observed that a Needle would not continue long in this State, but would every Day grow more and more regular; because if the Virtue be placed obliquely, it generally turns itself in the Direction of any Piece of Steel that is long and slender; and that may be the Reason why this Card is now become regular, except that it is inverted.

The Wires that join the Box seem weaker than when I first examin'd them; which makes it very probable that they might be vastly stronger when first struck with the Lightning: And the same may be likewise true, in regard to the Nails in the Binacle; which may account for the Experiments not answering exactly the same as at first.

From what has been said it appears, that this Form of Needles is very improper, and ought to be changed
for

for that of one strait Piece of Steel; and then if a Needle should be inverted it might still be used. It also shews the Absurdity of permitting Iron of any kind about the Compass-Box, or the Binacle. Whoever considers the whole Description here given of this Compass, I am persuaded, he will esteem it a most despicable Instrument: How then must any one be shocked to hear, that almost all the Compasses, made use of by our trading Vessels, are of the same sort! the Boxes all joined with iron Wire, and the same Degree of Accuracy observed throughout the Whole!

This I am credibly informed, is the Case; and that for no other Reason, but that one of this sort may be purchased for 5*s.* and it will cost about 2*s.* 6*d.* more to buy a tolerable good one. So that the Lives and Fortunes of thousands are every Day hazarded for such a trifling Consideration.